QMFCIAF REPORT NR. 24-61

VITAMIN RETENTION IN FORTIFIED FRUIT TABLETS DURING STORAGE

Interim Report
November 1961

QUARTERMASTER FOOD AND CONTAINER INSTITUTE FOR THE ARMED FORCES
QUARTERMASTER RESEARCH AND ENGINEERING COMMAND, U.S. ARMY
CHICAGO 9, ILLINOIS

QMFCIAF REPORT NR. 24-61

PROJECT: 7-84-06-032 Simplified Food Logistics

TASK: Development of rapidly rehydrating precooked dehydrated foods and design of quick-serve meals based on these, for 6-man and 25-man feeding requirements.

PHASE: Vitamin Fortification

VITAMIN RETENTION IN FORTIFIED FRUIT TABLETS DURING STORAGE

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by

Miriam H. Thomas

Nutrition Branch, Food Division

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Quartermaster Food and Container Institute for the Armed Forces

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INTRODUCTION

When a variety of common foods are consumed, such as occurs in normal civilian feeding and in the maintenance of troops on Field Rations A or B, not only are the recommended daily allowances of known vitamins supplied, but other vitamins for which requirements are less well known are also provided. However, in packaged operational rations, the original vitamin content is considerably decreased by processing and storage. Many packaged rations are adequate in the amount of vitamins provided only because of the use of vitamin-fortified ration items.

Before a ration item is investigated as a potential vitamin carrier, it must be established that the item has high general acceptability, good utility, stability for six months at 100°F, and properties which suggest a high retention of added vitamins. Confections, very desirable for rations because of their high caloric density and morale value, have been found to have high preference ratings (1) and are widely used in military rations. Since the stability of hard candy had been established previously, a study was undertaken to determine the suitability of fruit tablets for fortification with vitamin A, thiamine, ascorbic acid, and pyridoxine.[1/]

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1. At present, there is no military requirement specified by The Surgeon General's Office for pyridoxine. However, studies conducted by the Medical Nutrition Laboratory on stored packaged rations indicate that the pyridoxine content of rations may be marginal. Therefore, at the suggestion of the QM Industry-Advisory Committee on Vitamins, pyridoxine is being added to all experimental vitamin carriers. In those cases where the other vitamins under test are stable, recommendation is made to include pyridoxine as an insurance factor.

Experimental

Pineapple flavored fruit tablets were prepared by the Charms Company in accordance with MIL-C-10928C, Type VIII, Class 3 with the exception of the addition of vitamins. The vitamin fortification was added at an appropriate stage of processing at the level of one-half the daily recommended allowances of the National Research Council plus a sufficient average to compensate for processing losses (Table 1).

Table 1
Vitamin Fortification Added to Pineapple Fruit Tablets

Fortification	Concentration Per 1 oz. Serving A[1]	B[1]
Vitamin A palmitate	2752 units	2738 units
plus 30% excess	3578 units	3562 units
Thiamine mononitrate	0.9 mg	0.89 mg
plus 35% excess	1.2 mg	1.2 mg
Pyridoxine hydrochloride[2]	1.0 mg	1.0 mg
plus 10% excess	1.1 mg	1.1 mg
Ascorbic acid	27.5 mg	37.3 mg
plus 30% excess	48.75 mg	48.55 mg

1. A = 60% sucrose and 40% corn syrup
   B = sucrose
2. The level of fortification represents one-half the estimated daily requirement suggested by the Medical Nutrition Laboratory.

One experimental sample of candy was made with sucrose and another with a mixture of 60 percent sucrose and 40 percent corn syrup. The fortified and unfortified tablets were wrapped individually in cellophane and then wrapped 10 in a package made of metal-foil laminated to wax paper. The packaged samples were stored at 100°F. Samples removed from storage after six and 12 months were assayed for thiamine, vitamin A,

and ascorbic acid and examined for changes in palatability. The procedure for determining thiamine was the thiochrome method, ascorbic acid -- the photometric dye reduction method, and vitamin A -- the Carr-Price reaction (2). Samples were not assayed for their pyridoxine content.[2/] The sensory evaluation was made prior to storage and at each withdrawal by 20 consumers who rated each of four samples on the hedonic scale.

The accumulated periodic results were used to determine vitamin retention. These calculations were based on the amount of vitamin which was found in the product in the initial analyses. The difference between the initial value and the actual amount added to the product represented the processing loss.

Results and Discussion

During processing, approximately 50 percent of the added vitamin A was lost (Table 2). Thiamine and ascorbic acid losses were negligible.

Replicate analyses for the vitamin A, thiamine, and ascorbic acid contents were made initially to determine whether the distribution of the vitamins was homogeneous. The initial vitamin content and the standard deviation for each assay is shown in Table 3 as well as the vitamin content and retention during storage. There was no appreciable difference in the stability of thiamine or ascorbic acid in either candy base. In fact, these vitamins had excellent stability throughout the storage period. The results obtained with ascorbic acid are similar to those reported earlier by this laboratory (3) for the stability of

2. Present methods for determining pyridoxine are not satisfactory. The Nutrition Branch currently is developing a procedure for the assay of pyridoxine in food and food products.

Table 2

Initial Vitamin Content and Percent Loss During Processing of Pineapple Fruit Tablets

Vitamin	Amount added	Amount found	Processing loss %
Vitamin A palmitate			
Candy A[1]	3578 units	1837 units	49
Candy B[1]	3562 units	1543 units	57
Thiamine mononitrate			
Candy A	1.2 mg	1.3 mg	+8
Candy B	1.2 mg	1.1 mg	8
Ascorbic acid			
Candy A	48.75 mg	52.1 mg	+7
Candy B	48.55 mg	47.4 mg	2

1. A = 60% sucrose and 40% corn syrup
   B = sucrose

Table 3

Vitamin Content and Percent Retention During Storage at 100°F. for One Year in Fruit Tablets

Sample[1]	Storage interval mo.	Vitamin content					
		Vitamin A Units/oz.	%R[2]	Thiamine mg/oz.	%R	Ascorbic acid mg/oz.	%R
A	0	1837±13[3]		1.28±0.04		52.6±0.4	
	6	1335	73	1.25	98	54.0	103
	12	1172	64	1.38	108	51.3	98
B	0	1543±27		1.14±0.04		47.4±0.2	
	6	1306	85	1.17	103	45.9	97
	12	1503	97	1.06	93	43.8	92

1. A = 60% sucrose and 40% corn syrup
   B = sucrose
2. %R = Percent retention
3. Standard Deviation

ascorbic acid in hard candy. The previous study indicated hard candy retained 90 to 100 percent of the added ascorbic acid for at least one year.

Vitamin A, however, was less stable in the presence of corn syrup than when only sucrose was used as the candy base and continued to decrease in the mixed candy base as the storage period increased. In the sample prepared with sucrose, values obtained for vitamin A after a year's storage were greater than those obtained after six month's storage. No explanation can be offered for these results, but it can be assumed that vitamin A has good stability in a candy base of sucrose.

The palatability of these candies as a whole was good. Table 4 shows the mean palatability ratings for the candies during storage and the over-all averages for the various treatments. The mean ratings for all samples decreased after six months and remained approximately the the same until the end of storage. An analysis of variance on the results indicated that the average decrease in preference was significant at the five percent level. The difference between ratings for fortified and unfortified candy prepared with sucrose was significant also, the unfortified sample being preferred. The decrease in preference for the candy with the sucrose base may be due to the better stability of vitamin A in this product, since in previous experimentation the presence of vitamin A was found to decrease palatability ratings for cocoa beverage powder (4,5). The change in preference for this product, however, was not considered to be great enough to result in an unacceptable item.

Table 4
Mean Palatability Ratings for Fruit
Tablets During Storage for One Year at 100°F.

Storage time Mo.	Mean Palatability Ratings				
	Sample[1]				
	Unfortified		Fortified		Over-all average
	A	B	A	B	
0	6.9	7.1	6.9	7.3	7.0
6	6.3	6.6	6.5	5.4	6.2
12	6.5	6.4	6.9	5.6	6.3
Over-all average	6.6	6.7	6.7	6.1	6.5

1. A = 60% sucrose and 40% corn syrup
   B = sucrose

Recommendations

On the basis of the results presented above, it is recommended that the specification for fruit tablets include the addition of vitamin A palmitate, thiamine mononitrate, ascorbic acid, and pyridoxine hydrochloride at the level of 1250 U.S.P. units, 0.5 mg, 20 mg, and 0.5 mg per ounce, respectively. The vitamin A shall be a concentrate of vitamin A ester (palmitate). The palmitate shall be of edible quality and refined so that when introduced into the product at the required level, it will impart no fishy or other objectionable odor or flavor to the product. The remaining vitamins should be of a grade with Pharmacopoeia of the United States.

Summary

Fruit tablets have been fortified with vitamins A, C, thiamine, and pyridoxine and stored one year at 100°F. Good retention of ascorbic acid and thiamine was obtained throughout storage and palatability ratings were not affected by their presence. Vitamin A stability was affected by the type of candy base employed being more stable in sucrose than in a mixture of 60 percent sucrose with 40 percent corn syrup. The presence of vitamin A lowered palatability ratings for fruit tablets, but not enough to exclude fortification with this vitamin. No analyses were made for pyridoxine content.

Acknowledgement

Appreciation is extended to the Cereal and General Products Branch for procurement of the experimental samples, the Acceptance Branch for the palatability tests, and Mrs. Belle Rosler and Mr. Lawrence Wills, Nutrition Branch for performing the vitamin analyses.

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Vitamin Retention in Fortified Fruit Tablets during Storage by M.H. Thomas

Fruit tablets have been fortified with vitamins A,C, thiamine, and pyridoxine and stored one year at 100°F. Good retention of ascorbic acid and thiamine

Primary Field: Nutrition
Secondary Field(s): Vitamin fortification

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2. Food Storage
3. Fruit
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